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News

Weather, Land Satellite Sale

President Ronald Reagan announced on March 8 plans to sell to private industry the nation's land and meteorological remote-sensing satellites, including the responsibility for any future ocean-observing systems. According to the plan, the private firm successful in its bid to buy the five satellites would sell back to the government the data received by the satellites. The Reagan administration says the sale will save money and will put activities appropriate for commercial ventures into the commercial sector. Response to the announcement from scientists and congressmen has been anything but dulcet; one senator, in fact, charges that the Commerce Department and the corporation most likely to purchase the satellites are engaged in a 'sweetheart deal.'

Immediate concerns expressed by scientists and congressmen over the sale of the satellites include the potential for interruption of service resulting from corporate financial difficulties or labor disputes; the possible disruption of information flow to international users of U.S. satellite data; the possibility of data being subject to copyright; and the question of a commercial satellite company having a monopoly on the satellite data essential to the U.S. government. Critics also question whether the government will save any money by selling the LANDSAT land remote-sensing satellite, the two polar orbiting satellites, and the two geostationary operational environmental satellites (GOES).

The National Weather Service (NWS), within the Commerce Department's National Oceanic and Atmospheric Administration (NOAA), would not be dismantled or sold, according to NOAA Administrator John V. Byrne.

The plan to sell the satellites, according to NOAA officials, was prompted by the Office of Management and Budget (OMB); OMB wanted to eliminate the costly LANDSAT program, which supplies information used by, among others, seismologists, geologists, farmers, and urban planners. However, because the market for the LANDSAT data is small, commercial ventures were reluctant to buy the satellite but were more interested in purchasing the weather satellites, thereby buying into the huge market for weather information. According to one current estimate, the public spends $100 million a year accessing prerecorded telephone weather information, and the media spends $1.7 billion to disseminate weather information. NOAA Administrator Byrne noted that bids would be accepted only from U.S. firms and would be accepted for either the weather satellites, the land satellite, or all of the remote-sensing satellites.

The Communications Satellite Corporation, better known as Comsat, is considered the frontrunner among the firms that would be willing to buy the remote sensing satellites. In fact, Comsat made a proposal to the government in the spring of 1981 to purchase both the land and meteorological satellites. That proposal reportedly states that Comsat would be willing to buy the satellites if the government would guarantee that it would pay roughly $300 million a year for 15 years. In a statement issued in response to Reagan's announcement, Comsat said that 'such a transfer is possible without a disruption in the service provided to national and international users and will ensure the continued development in the U.S. of this very important [satellite] technology.' A Comsat spokesman said it would be premature to comment on any possible savings that might accrue to the government as a result of the sale.

Much of the criticism of the plan stems from the apparent lack of a cost-benefit analysis to determine if the government would indeed save money by selling the satellites. At a March 14 Senate hearing on the NWS budget, Sen. Larry Pressler (R-S.D.) revealed that the Commerce Department was sent a report in November from the Department of Defense and the National Aeronautics and Space Administration (NASA) claiming that the government would spend more money buying back weather and land data from private companies than would it would spend if the government kept the satellites. In spite of this report's analysis, Pressler says, the Reagan administration has gone ahead with plans to sell the satellites. The South Dakota senator accused the Commerce Department and Comsat of being involved in a 'sweetheart deal.'

Dated November 10, 1982, the report referred to by Pressler was sent to Assistant Deputy Secretary of Commerce Michael Bayer from Major General Earl G. Peck of the Defense Department and Kathleen Charles of NASA. According to Kevin Schieffer, legislative assistant to Pressler, the report is a 'broad-base analysis' based on reports requested from more than a dozen companies on the pros and cons of the commercialization of land and weather satellites. However, the existence of the report, or any other study on the cost effectiveness of selling the satellites to the private sector, was not known to any of the more than a dozen witnesses testifying in mid March in House and Senate hearings on the proposed fiscal 1984 budget for NWS. Though labelled 'official use only,' the Peck-Charles report contains no proprietary information, Schieffer said. Pressler has requested that the Senate Committee on Commerce, Science, and Transportation ask Bayer to make the report available to scientists and others for evaluation of the costs and benefits of commercializing the remote-sensing satellites.

Pressler, whose home state is also home to the Interior Department's EROS (Earth Resources Observation Systems) Data Center, introduced into the Senate on February 15 a bill (S. 480) to block the Secretary of Commerce from transferring the ownership or management of any civil land or meteorological remote sensing space satellite system and associated ground equipment without congressional approval. Rep. Roy P. Dyson (D-Md.) introduced a companion bill (H.R. 1958) in the House on March 8, the day of Reagan's announcement. Both bills have been sent to committee. Hearings on the proposal have not been scheduled, but are likely to be held in late spring following budget deliberations.—*BTR*

UCAR Group Urges STORM Program

A blue-ribbon panel of scientists has proposed a decade-long, $1 billion program to improve forecasting operations and research of regional and local hazardous weather. The panel, appointed by the University Corporation for Atmospheric Research (UCAR), believes that the program could reduce the $20-billion annual cost of damage from severe weather by $1 billion per year.

The primary aim of the program is to 'enable weather services, public and private, to observe and predict stormscale weather phenomena—such as squall lines, thunderstorms, flash floods, local heavy snows, or tornadoes—with the accuracy and reliability to protect the public, serve the national economy, and meet defense requirements,' as explained in the report, *The National STORM (Stormscale Operational and Research Meteorology) Program: A Call to Action*. Stormscale phenomena also include nonviolent weather: freezing rain, dense ground fog, low-lying clouds that disrupt ground or air traffic, persistent temperature inversions, and strong nocturnal cooling that may produce killing frost.

'Stormscale phenomena are closely related to large-scale weather,' according to George S. Benton, professor of meteorology at the Johns Hopkins University and chairman of the UCAR committee, who testified before the House Subcommittee on Natural Resources, Agricultural Resources, and Environment on March 9. 'It is the distribution of large-scale cyclones and anticyclones—low and high pressure areas—that determines whether a broad region has predominantly stormy or fair weather. But it is the occurrence,' he continued, 'of stormscale phenomena which determines the *particular* [sic] locality within the stormy region that experiences the devastating flash flood or the destructive windstorm. Stormscale phenomena are embedded within the large-scale weather patterns, and it is often the specific location and time of occurrence of the stormscale events that are of the greatest concern to our citizens.'

The operations portion of the National STORM Program aims to deploy the technology essential to gathering, analyzing, predicting, and disseminating small-scale weather information; the research portion, on the other hand, would ensure that the new-generation, high-technology operational system would be used to its maximum benefit. The research portion of STORM also aims to train forecasters to use the new predictive techniques.

'Accurate stormscale weather forecasting will become a reality provided that the technology available to weather services is improved in four fundamental ways' under the operational part of the STORM program, the UCAR committee states in its report. First, existing remote sensing systems must be better utilized to improve the observation of stormscale weather systems. In particular, a modern radar network is needed. Second, better communication and processing systems must be made available to the forecaster, the committee contends, to permit the rapid and accurate display and analysis of local weather information from several sources. Radar or satellite pictures, for example, would show the development and movement of stormscale phenomena. Third, forecasters need better conceptual and numerical models to provide a stronger foundation not only for short-term forecasts, but also for application to forecasts of greater than 12 hours. Last, the committee says that equipment and systems must be installed to help forecasters prepare and rapidly distribute stormscale weather predictions that would be meaningful to the public.

According to the recently published report, the six-plank research program aims to (1) improve understanding of local and regional weather phenomena and to apply this knowledge to a variety of closely related fields; (2) develop and evaluate local and regional weather prediction models; (3) develop stormscale monitoring and forecasting capabilities applicable to data-sparse areas; (4) develop and test new observing systems; (5) test and evaluate systems of data assimilation, archival, and display; and (6) develop techniques of educating and training meteorologists in stormscale weather forecasting.

The three latter objectives are vital to the program and closely link the research and operations portions, Benton emphasized at a recent press conference to unveil STORM. No matter how good the predictions, they are of no value unless they can be transmitted rapidly by trained meteorologists to those people who need and use them, he noted.

The UCAR committee believes that three key ingredients have primed meteorology for a successful stormscale program: 'vastly improved understanding of and ability to predict the large-scale motions of the atmosphere'; the technology 'to observe, analyze, and disseminate stormscale weather information with a level of sophistication substantially greater than would have been possible only ten years ago'; and the 'availability of improved computers.'

At least seven major federal departments and agencies would be closely involved with the program: the departments of Commerce (in particular, the National Oceanic and Atmospheric Administration), Defense, Interior, and Transportation, the Federal Protection Agency, the National Aeronautics and Space Administration, and the National Science Foundation (NSF). The UCAR committee encourages these agencies and departments to establish a program coordinating office as the next step in the STORM program's development. The committee also recommends that a scientific organizing committee be established within the National Academy of Sciences within the next few months and that a program advisory committee be assembled within 1985 for more detailing program planning. UCAR, a consortium of 50 universities that manages, under contract with NSF, the National Center for Atmospheric Research (NCAR), was a catalyst in developing the National STORM Program.

During 1985–1988, the first of three pro-

Editorial

On Beginning A Career

At the 1982 AGU Fall Meeting, about 50 young men and women attended a panel discussion entitled 'Doubts and Discouragements: Beginning a Career' sponsored by AGU's Education and Human Resources Committee. The panelists (Joyce Blueford, U.S. Geological Survey; Constance Sancetta, Lamont-Doherty Geological Observatory; and Percy Donaghay, University of Rhode Island) focused the wide ranging discussion on the special problems of graduate study and early professional life.

Blueford urged students to assess all of the possible careers. Too often students are exposed only to the academic teaching and research role. She suggested that each person periodically outline his or her own priorities and lifestyle to see what type of job fits, pointing out that one's desires and ideas change as one develops. To find out about job advantages and drawbacks, she suggested that one should contact graduates of one's school to see what they have done. Once the job type is determined, the young person must develop the right image, work hard, and make contacts to get ahead.

Sancetta discussed some of the problems encountered by graduate students. She felt that some drop out because they are uncertain of the direction in which they want to go. Others doubt their own ability to do creative, independent science. She stressed that these doubts are common to everyone, and that goals and confidence solidify as one advances. Another common feeling is that of being ignored and getting little support from advisors—the 'I don't get no respect' syndrome. The student feels isolated and thinks that no one really cares how he or she is doing. It is important to talk about these feelings and ask for help, she said. 'The faculty may be more supportive than you think, but they don't automatically know how you feel; you must go and tell them.'

Donaghay outlined the problems of the young professional trying to become established in a crowded field. He suggested that if one goes for 'hard money' (income provided by guaranteed salary) in academics, it means taking a heavy teaching load, which eliminates most of the research time, only to be told at promotion time that 'teaching counts for nothing; promotion is based upon publication.' Percy advised future assistant professors to check the history of promotion at each school, since standards differ. A 'soft money' (income contingent on grants) research job is often an umbrella project, in which several young scientists cooperate under the guidance of a senior scientist. This is very appealing; someone else worries about the funding while you are doing exciting work on the cutting edge, but the young scientist runs the risk of becoming an 'et al.'

'You must identify yourself as a unique scientist doing unique work,' said Donaghay. This can be done by giving talks at meetings and seminars at other institutions and by publishing papers on which you are sole author. However, as you begin to define yourself you will come in conflict with established people whose ideas you question and with whom you start to compete for funding. 'You are bound to step on a few toes sooner or later if you do exciting work, and you will have to realize that that's the way science grows and not be crushed by the fights you lose.'

Remarks by members of the audience brought out several points. An older woman suggested that young scientists adopt a mentor, an older and more experienced person willing to give advice, introduce one to senior colleagues, and explain how the system works. Several people noted that nice guys can finish first; that it is possible to be successful and self-confident while retaining a concern for others. Most students in the audience seemed to see their advisors as insensitive egotists making rigid demands; many expressed a desire that faculty give those who will not go into academics more information on alternative careers. Dr. Barbara Emery of the National Center for Atmospheric Research said that she had found teamwork boring when she performed only her part of the routine; once she took the initiative to shoulder more responsibility she enjoyed it much more. Dr. Louise Levien of Exxon Production Research Co. urged people not to give up if the first job is disappointing. 'Give science another chance in another place before you decide it's not for you.'

A problem which was discussed at some length is one of concern to young women: the apparent impossibility of sustaining a full-time, demanding job and also having a family. Aside from the personal joy of having a family, it was felt that parenting is an important contribution; but the system at present does not allow for part-time workers, who may produce less per year but are still doing valuable research. A different standard of promotion or award might be applied to such people, although it is hard to know what the standard might be; it would represent a basic change in the system. Those women who *have been most successful have either been young when they had children* and then worked very hard to catch up, or had children after they had become established. The panel cautioned young women not to set unreasonable goals for themselves, but to find a workable way to satisfy both parts of their lives.

The Committee plans to hold another panel at the 1983 AGU Spring Meeting, with speakers from academia, government agencies, industry, and consulting firms to discuss the relative advantages and drawbacks of various career directions.

Constance Sancetta, *Member*
Charles Hollister, *Chairman*
AGU Education and Human Resources Committee

posed program phases, the first multi-scale field experiment would be planned, a small field program with limited objectives would be conducted, and data sets would be analyzed. During the second phase (1987–1991), the later multi-scale field experiment would be planned and conducted, and analysis of the data from these experiments would begin. The last phase of the program (to extend as late as 1995) would see the analysis of the data from all of the experiments completed. Throughout the entire period, other research—including modeling studies, technology development, and the transfer of information and techniques to the operational community—would be conducted.

In addition to chairman Benton, the National STORM Program committee also includes Ernest M. Agee (Purdue University); Richard A. Anthes (NCAR); Lance F. Bosart (State University of New York at Albany); Michael Fritsch (Pennsylvania State University); Peter V. Hobbs (University of Washington); John Hovermale (National Meteorological Center); Robert McClatchey (Air Force Geophysics Laboratory); Isidoro Orlanski (Geophysical Fluid Dynamics Laboratory); Frederick Sanders (Massachusetts Institute of Technology); Robert J. Serafin (NCAR); Patrick Squires (NCAR); and Verner E. Suomi (University of Wisconsin–Madison).—*BTR*

Sunspots Affect Insolation

The notion of a rigorously constant amount of solar radiation reaching the earth was upset recently by a team of scientists at the National Center for Atmospheric Research (NCAR). John Eddy, Ronald Gilliland, and Douglas Hoyt of NCAR's High Altitude Observatory report that sunspots, which speckle the sun's surface in a fluctuating 11-year cycle, diminish the amount of sunlight reaching the earth. Their conclusion, which may radically affect global climate modeling, is based on data gathered from the Solar Maximum Mission (SMM) satellite and their own solar blocking model.

Data collected by the SMM satellite reveal that only a small fraction of the energy blocked by sunspots is balanced by immediate, enhanced emissions from bright areas on the sun. Moreover, solar energy can remain trapped in the sunspots, which have an average diameter of 9000 km, for years. Blocked radiative energy can be stored in the lower convective zone of the sun and have a 'relaxation-time scale' of 100,000 years, during which time it may slowly seep out. Fluctuating solar output affects the accuracy of global climate models that forecast long-term effects on the world's weather; Weather and climate are determined by the circulation patterns of the oceans and air, which are driven by solar energy coupled with the rotational inertia of the spinning planet.

The NCAR scientists compared data obtained from the Active Cavity Radiometer Irradiance Monitor (ACRIM) aboard the SMM satellite with terrestrial surface temperature data and, using their solar blocking model, successfully duplicated the patterns of energy fluctuations. They can now predict the short-term excursions in solar radiation a few days in advance, the scientists say, based on measurements of sunspot areas and their locations along with the known rotational properties of the sun. In addition, they can reconstruct the history of past fluctuations in solar radiation from the archived sunspot data of the past 108 years.

Launched February 14, 1980, the SMM satellite has detected variances of 0.1% in solar energy output. Such fluctuations correspond to a change of 10 °C in the average temperature of the sun, which is 5700 °C. If the variance is persistent, the scientists say, the earth's surface will respond directly and predictably; global cooling will follow a decrease in solar radiation and global warming will follow an increase.

Theoretically, fluctuations in the release of solar energy can affect climate profoundly (*Eos*, August 26, 1980, p. 596). Mean global temperatures would drop more than 1 °C in response to a 1% decrease in output of solar radiation. A drop in output of energy of only 6% would cover the entire earth with ice.—*MEG*

Long Valley Earthquakes Wane

The intense swarm of earthquakes that began January 6, 1983, in the Long Valley region of eastern California continues to abate. The rate of earthquakes of magnitude 1 or greater (Richter scale) fell to 24 per day by February 8, compared to 100 per day in late January and 1000 tremblers recorded on January 7. Prior to the current swarm, the average daily number of magnitude 1 or greater quakes was 8–10. The area has experienced more than eight seismic swarms since the four magnitude 5.6–6.1 earthquakes of May 25–27, 1980, that occurred in the southern part of the Long Valley caldera. Early ground deformation measurements indicate limited movement of magma deep within the earth.

However, despite the current abatement, recent brief flurries of activity were recorded when two magnitude 4 and one magnitude 3.5 earthquakes occurred on February 3 and 4, respectively. In addition, a magnitude 4.1 earthquake was recorded on February 24.

The seismic activity that began in January has resulted in ground extensions of 3 cm in 6 km and uplifts of 8 cm as indicated by laser-distance measurements and precision surveying. According to U.S. Geological Survey (USGS) seismologist David P. Hill, the changes are more pronounced near the epicentral region which is 3 to 8 km east of the town of Mammoth Lakes. The town is located on the southwest edge of the 17 km by 32 km elliptical caldera. Spasmodic tremors also have been recorded at this site.

Volcanologists consider spasmodic tremors as indicative of rock fracturing caused by the movement of magma or magmatic gases (*Science*, June 18, 1982, p. 1302). Reanalysis of the May 1980 earthquakes indicates that they were the result of a rapidly expanding crack that immediately filled with fluid. A USGS preliminary model to account for the latest deformation suggests movement of up to 20 cm on the seismically defined fault zone, accompanied by up to 76 cm of opening within that zone. The right-lateral slip movement is consistent with the seismically determined mechanism for the earthquakes according to Hill.

Previous seismic studies revealed the existence of a magma chamber near the town of Mammoth Lakes. Approximate measurements place it at a depth of between 8 km and 15 km and a distance across of 10 km. The 1980 tremors and the appearance of steam vents in January 1982 in the caldera region indicated to researchers that magma from deep in the earth was moving upward (*Science*, June 18, 1982, p. 1302).

Despite the recent decline in seismic activity, the Long Valley-Mammoth Lakes area remains covered by a notice of potential volcanic hazards issued by the USGS in May 1982. The region also is under an earthquake hazards watch, which has been in effect since May 1980.

Wet February for Nation's Streams

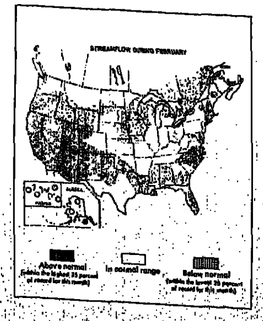
February marked a very wet month for the nation's streams with 97% of the key index gaging stations across the country reporting average to above-average streamflow, according to the U.S. Geological Survey.

USGS hydrologists said that the only stations that reported below-normal conditions for February were one gaging station each in New York, New Jersey, Ohio, and Alaska and all four of the key index stations in the Hawaiian Islands.

The near drought conditions on the Hawaiian Islands were a strong contrast to the generally wet conditions across the continental United States. All four of the key index gaging stations on the Islands reported streamflows well below average for February. On the large Island of Hawaii, the key index gage on Waiakea Stream near Mountain View reported several days of zero flow during the month. Kilauea Volcano, located on the Island of Hawaii, has erupted several times during the past two months, and the lack of moisture combined with the intense heat from the lava flow increased the threat of vegetation fires on the island.

As an indication of the nation's generally plentiful water picture, combined flow of the nation's 'Big Five' rivers—Mississippi, St. Lawrence, Columbia, Ohio, and Missouri—averaged 889 billion gallons a day (bgd), 11% above the long-term average for February. The Big Five, which together drain more than half of the conterminous United States, provide hydrologists with a convenient check on overall national water conditions.

February marks the ninth straight month that the combined flow of the Big Five has been above average. Near the end of February, total daily flow of the Big Five was running 24% above the long-term combined monthly average, indicating that wet conditions could extend at least into early March.



Increased streamflows in February helped to halt a developing drought threat along much of the East Coast and inland to northern Alabama. All but two of the 31 key index gaging stations in New York, New Jersey, Pennsylvania, Maryland, Virginia, West Virginia, Kentucky and Tennessee reported average to above-average streamflow during February. In contrast, during January each of these states had reported well-below average streamflow at one or more index stations.

Working in cooperation with federal, state and local officials, USGS hydrologists routinely collect data on streamflow and ground-water conditions at more than 45,000 sites across the country. Highlights of February water conditions:

Big Five: Individual February flows—Mississippi River near Vicksburg, Miss., 494 bgd, 13% above average, but down 27% from January's flood volume; St. Lawrence River near Massena, N.Y., 158 bgd, 5% above average and 6% above the January average flow; Columbia River at The Dalles, Ore., 89 bgd, 35% above average and 8% above last month's flow; Ohio River at Louisville, Ky., 88 bgd, 22% below average, but up 44% from the January flow; and the Missouri River at Hermann, Mo., 60 bgd, 87% above average and 17% above last month.

Ground-water conditions: Ground-water conditions varied across the country. The water level in key index wells in Kentucky, Nebraska, North Dakota and Nevada set new record highs for February. All four of the key index wells in North Carolina reported water levels that were one to four feet above the long-term average. Ground-water conditions in Delaware and Maryland remained well below average, with one key index well near Fairland, Maryland, reporting the 29th consecutive month of below-average water levels. The water level in a key index well near El Paso, Texas, fell to 78 m below the land surface, the lowest level reported at this well in 18 years of record.

Detecting Electron Precipitation

Preliminary results were recently reported from the Navy's Stimulated Emission of Energetic Particles (SEEP) satellite regarding detection of stimulated magnetospheric electron precipitation from ground based Navy VLF transmitters (*Eos*, January 18, 1983). The results, first released at the AGU Fall Meeting, were obtained on passes during mid-August 1982, using coded transmitter pulses with a duty cycle of 3 s 'on,' 2 s 'off.'

We note here that a similar experiment was conducted by the National Aeronautics and Space Administration (NASA) using low-cost, recoverable rocket payloads from Wallops Island, Virginia, during late June and early July 1982. These flights also used the Navy VLF transmitter (NSS) at Annapolis, Maryland, with the same coding as that used for the later SEEP experiment. Participants in the NASA experiment included scientists from Goddard Space Flight Center, Denver University, and Cornell University. The results of this experiment, also reported at the AGU Fall Meeting, show evidence for pulsed electron precipitation patterns with the same period as the transmitted VLF pulses. These results were accomplished by sensing the bremsstrahlung X rays produced when the electrons reenter the atmosphere. A zenith-viewing, wide angle X ray detector was stabilized with a slow descent aboard a parachute-hung payload; this permitted a statistical build-up of the X ray signals over thirty 5-s cycles, a benefit not afforded by a fast moving satellite. Cross correlation analyses of the X ray data with the transmitted signal clearly demonstrated the existence of this effect at a detectable level under nighttime conditions. The SEEP results, which measured the precipitating electrons in situ, are consistent with these earlier NASA findings.

The NASA result was used to establish the role of both anthropogenic and natural VLF sources as a magnetospheric stimulant. In particular, lightning appears to be a reasonable candidate for producing a continuous stream of magnetospheric electron drizzle, since approximately 2000 thunderstorms occur over the globe at any instant. Comparisons of the VLF energy from the VLF transmitter to that from lightning were made with onboard VLF receivers and show the lightning source to be larger on average by a factor of 10. More details on the NASA results can be found in an upcoming issue of *Science* under the title 'Controlled Stimulation of Magnetospheric Electrons by Radio Waves: Experimental Model for Lightning Effects' by R. A. Goldberg et al.

This news item was submitted by R. E. Hartle of the NASA/Goddard Space Flight Center, Laboratory for Planetary Atmospheres, Greenbelt, MD 20771.

Forum

Research Funds

Joseph Walder's rambling diatribe against accepting research funds from the Department of Defense (*Eos*, December 28, 1982, p. 1346) deserves some rebuttal. In particular, I would like to respond to his question, 'Does acceptance of financial support from military sources make individuals and institutions dependent clients of the Pentagon?' The answer is: of course not, unless they want to be.

As an Air Force scientist and research contract manager, I can state categorically that we put no pressure upon our contractors to become our 'clients.' Indeed, we caution them not to become too dependent upon Air Force funds for continued funding of research projects, due to year-to-year changes in programs of interest to the Air Force and availability of funds. The only 'control' that we exert over contractors is their voluntary agreement to perform the work that they have unilaterally proposed to do by submitting an unsolicited proposal to us. These proposals are reviewed in-house, and funding is determined purely on relevance, availability of funds, and our estimate of the quality of the proposed research (investigators, facilities, etc.).

Thus, funding of a research project by the Air Force, at least in nonsensitive areas, is more volatile and has only slightly more stringent requirements (e.g., we usually require one scientific report or journal paper per year) than does funding by the National Science Foundation. This hardly makes our contractors our 'clients,' which I am sure can be attested to by the many in-state research scientists who have been funded by us over the years.

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Another AGU Index

I note that Juan G. Roederer has proposed an index of AGU affiliation named JGR (*Eos*, October 19, 1982, p. 817). According to this index, Alaska is the most AGU-involved state in the Union. I praise his customary modesty in disclaiming any connection between his initials and the name of the index. I think it only fitting that the index be applied on a worldwide basis since AGU in many ways transcends national boundaries, as indeed its subject matter does.

I propose that the worldwide index, applied to each country as the JGR index is applied to the states, should be named after either a well-known magnetic index or the Atmospheric Explorer spacecraft, i.e., it should be known as the AE index. I, of course, emulate Dr. Roederer in disclaiming any connection with my initials.

A tour around this part of the world with the AE index shows that Israel has an index of 10 compared with 2×10^{-3} for Egypt and even smaller values for other countries in the region. India has approximately the same number of AGU members as Israel with a population more than two orders of magnitude greater. Thus, it appears that Israel is the most AGU-oriented country in Asia.

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Education Bill Passes

On March 2 the U.S. House of Representatives passed a bill authorizing $425 million for science and mathematics education in fiscal 1984; the authorization is $350 million more than President Ronald Reagan requested in his budget proposal (*Eos*, February 15, 1983, p. 65).

H.R. 1310 allocates $205 million to the Department of Education not only to improve precollege instruction in science and math, but to beef up foreign language training to aid in improving international communication among scientists. The bill also allots $100 million to the National Science Foundation for a variety of programs, the lion's share of which aims to upgrade research equipment at colleges and universities. It is hoped that industry will match the $100 million targeted for this program.

Although the Senate has yet to draw up a companion bill, hearings were held by the Education, Arts, and Humanities subcommittee of the Senate Labor and Human Resources committee on March 8 and 9 on the Education Security Act and related science and mathematics legislation. Follow-up hearings are scheduled for April 7.—*BTR*

Books

Introduction to Tides: The Tides of the Waters of New England and New York

A. C. Redfield, Marine Science International, Woods Hole, Mass., 108 pp., 1980.

Reviewed by Malcolm J. Bowman

This interesting little book is not really about what its main title suggests, an introductory text on tides for oceanography students. Its subtitle gives more of a clue to its contents and intended readership. The author immediately points out in the preface that 'this book is written for the many intelligent people who work or play along the coast between Sandy Hook and the Bay of Fundy.'

In addition to discussing elementary tidal theory, the book describes in some detail the author's systematic analysis of coastal tides and currents in the New England and New York region. His analysis fits the solution of the telegrapher's equation to Tide Table predictions of tidal elevations and times of high water and slack current. In this way, Redfield separates the observed M_2 tides in various straits, embayments, hydraulic channels, and estuaries into damped, progressive waves travelling in opposite directions. These waves arise through reflection of the primary wave at the head of an embayment or estuary, or through two primary waves entering a tidal strait or hydraulic channel from both ends.

Using a nomographic method, the technique produces curves of mean tidal range and times of high tide and slack water along the waterway for optimum estimates of the damping and reflection coefficients. These predictions, well known from Redfield's pioneering use of the method in his series of papers during the 1950's, are quite good for the tidal height and interval but not for slack water. This is to be expected, since the equations were originally developed for use in a rectangular uniform channel, and take no account of the effects of weather, overtide generation, the earth's rotation, bathymetry, and varying cross sections of the waterways studied.

Unfortunately, most of the intended readers will probably not understand the summary of the theory as given in chapter 3, nor, therefore, its application; they will have to read the original papers for that. Even then only those familiar with elementary trigonometry and calculus will make much sense of it. (Coastal engineers have made much use of the method and a particularly good discussion is given in A. T. Ippen and D. R. F. Harleman, Tidal dynamics in estuaries, in *Estuary and Coastline Hydrodynamics*, edited by A. T. Ippen, McGraw-Hill, New York, 1966.)

Another criticism one could make of the text is that no mention is made of the whole realm of numerical tidal modeling. Numerical simulations are now sufficiently easy to apply and accurate to be of major importance in the production of tidal atlases of semi-enclosed seas and navigable waterways. In spite of this, and allowing for the limitations inherent in the fitting of linear, one-dimensional, damped wave theory to coastal tides, the book is immensely readable and will find its way to the bookshelves of mariners, amateur scientists, and oceanographers all along the northeastern seaboard. Professional coastal oceanographers will also find it a quick source of useful facts and figures.

One thing Alfred Redfield does not disclose is the secret of his longevity. How a man had the energy and lucidity to produce such an interesting book as he approached his ninetieth birthday is a source of wonder to me. Perhaps the characteristics cited by the late Bostwick H. Ketchum in his foreword ('his interest in natural phenomena and his curiosity about them have been undiminished by passing years') have had a lot to do with it.

Malcolm J. Bowman is with the Marine Sciences Research Center, State University of New York at Stony Brook.

Igneous Rocks of the British Isles

D. S. Sutherland (Ed.), Wiley-Interscience, New York, xv + 645 pp., 1982.

Reviewed by K. L. Currie

Much of the foundation of petrology was laid on the igneous rocks of the British Isles—one need only recall the Tertiary igneous rocks of northern Scotland. However, the relations between various occurrences of these igneous rocks (and in some cases even their locations) have remained obscure for many of us familiar with the British Isles only through the voluminous literature. This weighty and densely written tome will serve as a most useful guide and reference for all those interested in British igneous rocks. The volume specifically aims to continue that grand classic of observational geology, *Ancient Volcanoes of Great Britain* by Archibald Geikie. It does not achieve quite that level but will surely remain an indispensable general reference for many years if only because of its extensive bibliography.

The volume includes contributions by 37 coauthors divided into seven parts and three appendices. The rocks have been divided according to age and type, namely the Precambrian, Lower Paleozoic volcanic rocks, Caledonian intrusive rocks, Devonian and Carboniferous volcanism, Hercynian intrusive rocks, Late Paleozoic and Mesozoic igneous activity, and the British Tertiary province; petrographic, chemical, and isotopic details are relegated to three appendices. Each part is further broken down into a general introduction followed by several articles on particular occurrences or aspects of the igneous rocks.

The usefulness of reference books of this kind depends on the quality of the introductory chapters and on the completeness of the indices. In both respects this volume rates high. The indices are exceptionally good, and the introductory chapters do a good job at placing the later material in context, although I was rather overwhelmed by the profusion of place names. This generally laudatory comment does not imply that anyone can readily sit down and get an overall picture of the igneous history of the British Isles from this book. In the first place there are certain difficulties of organization, perhaps inevitable. Only peripherally and in passing is it noted that the part on Devonian and Carboniferous volcanism treats rocks contemporary with, and possibly comagmatic with, Caledonian and Hercynian intrusives. The quality of the writing varies from pedestrian to extremely dense. I found it heavy going because of the wealth of references and the attempt to get the maximum number of facts into the minimum amount of space. Still, the facts are there if the reader will dig for them. A wealth of small locality maps greatly aid the visualization. Occasionally these maps cannot be easily referred to larger scale maps, but in general the 'hierarchical' organization is good. The number of photos is limited, but their quality is excellent.

The various articles treat mainly of descriptive aspects of the rocks with sketches and localities. Some authors treat bulk chemical data by presenting various diagrams, but there is little treatment of mineral chemistry or of specialized chemical data such as rare earths, although such details can in general be traced in the very extensive bibliography. Treatment of petrological problems is sketchy and superficial. Some sections are quite repetitive, particularly the one on the Tertiary, where Mull and Arran are treated in three successive articles. The distribution of space may seem somewhat idiosyncratic also. The Tertiary rocks receive the most space, 133 pages, which is not unreasonable, but 34 pages for the celebrated Hercynian granites of Cornwall, when compared with 68 pages for Carboniferous-Permian volcanism and 88 for lower Paleozoic volcanism, seems somewhat unbalanced. The selection of data for the appendices exhibits some peculiarities. The appendix on petrography starts off with a modest encomium to the Streckeisen classification and then reverts to such terminological monstrosities as 'marscoite,' 'tregelvanite,' and 'rockallite.' According to the chemical data, trace element analyses are rare or absent for the Tertiary province and for the Caledonian intrusives.

Despite these reservations, the book clearly succeeds in its object of giving condensed descriptions of the significant localities of igneous rocks in the British Isles. The question remains whether there is a clientele for such a large, expensive, and specialized book. It cannot be read for sheer pleasure, unlike its distinguished predecessor, *Ancient Volcanoes of Great Britain*. The quantity and level of information are insufficient for specialists wishing to study a particular complex either in the field or in the literature, although it will undoubtedly be of great use as a guide and entry to the literature. The obvious place for this book is therefore on the reference shelf of libraries, where it will doubtless remain the standard work on the subject for many years. Few individuals will be interested in this book for their private library.

K. L. Currie is with the Geological Survey of Canada, Ottawa, Ontario.

EOS
Transactions, American Geophysical Union
The Weekly Newspaper of Geophysics

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Cover. Roll clouds spell trouble; they are often on the leading edge of heavy thunderstorms that can produce hail, high winds, and heavy rain. The clouds, such as those over Miles City, Mont., pictured on the cover, are but one of the many phenomena portending geographically limited but severe stormscale weather. A call for action has been issued for a National STORM (Stormscale Operational and Research Meteorology) Program to enable meteorologists to observe and predict such small-scale weather and to apply the improved predictions to protecting the public, the national economy, and meeting defense requirements. Proponents of the 10-year, $1-billion program say it could save 5% of the annual $20 billion lost to severe weather. See related news story, this issue. (Photo courtesy of Phil Roskowski, National Center for Atmospheric Research/National Science Foundation.)

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c/o Vera Ballard
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Postdoctoral Research Associate in Geophysical Fluid Dynamics: University of Southern California. Applications are invited for a research appointment in Geophysical Fluid Dynamics. The successful applicant would be expected to spend the majority of his time working on laboratory models of coastal upwelling. Appointment can begin immediately. Applicants should possess a recent Ph.D. degree in a relevant area of engineering, oceanography or physics. A complete resume and at least three letters of recommendation should be sent to Prof. T. Maxworthy, OHE 430, Department of Mechanical Engineering, University of Southern California, Los Angeles, CA 90089-1453. EOE/MFH

President/University Corporation for Atmospheric Research (UCAR), Boulder, Colorado. The Search Committee of the UCAR Board of Trustees invites nominations and applications for the President and Chief Executive Officer of UCAR. The Board of Trustees expects to fill the position promptly and seeks to have the individual in office on July 1 or as soon after 1 July 1983 as possible.

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Dr. Thomas M. Donahue
Chairman, Search Committee
UCAR
P.O. Box 3000
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Geophysicist. The Air Force Technical Applications Center (AFTAC) is seeking candidates for a staff geophysicist to supervise research in nuclear test detection seismology and hydroacoustics. Duties include in-house research on discrimination between earthquakes and explosions, technical supervision of contractor research and advising management in the candidate's area of expertise. AFTAC is located at Patrick AFB, Florida. Grade level GS-1515-13, Salary $34,030. Send a current SF 171 to Huntsville Area Office, Office of Personnel Management, Southerland Bldg., 806 Governors Drive, S.W., Huntsville, AL 35801. For more information, call C. Thirlwell (305) 494-7663. Equal Opportunity Employer.

Assistant Professor Position/University of Mississippi. The Department of Geology and Geological Engineering, University of Mississippi, has a tenure track assistant professor opening beginning Fall semester 1983. The position is open to the following geoscience specialties in descending order of priority: geophysics, geohydrology, petrology, stratigraphy, geological engineering, igneous/metamorphic petrology,, micropaleontology. A Ph.D. is required. Application deadline—May 31, 1983, to ensure consideration; applications will be received until the position is filled. Send resume and the names, addresses and phone numbers of three references to:

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Further particulars may be obtained from the Secretary of the University Court, (Room 18), University of Glasgow, Glasgow, G12 8QQ, with whom applications (8 copies; 1 copy in the case of overseas applicants), giving the names and addresses of three referees, should be lodged on or before 6th May, 1983. Late applications from overseas will be considered; telegram in the first instance if necessary.

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AGU Panel Meets On Career Topics

Graduate students and their career opportunities in ocean and earth sciences were the focus of the Education and Human Resources (E & HR) Committee meeting held at the 1982 AGU Fall Meeting in San Francisco. A standing committee of AGU, the E & HR committee is responsible for matters concerning education in earth, ocean, and planetary sciences from precollege through graduate programs, including career guidance, academic preparation, student recruitment, and manpower supply and demand.

At the meeting a draft of the AGU-sponsored *Careers in Oceanography* booklet by committee chairman G. Hollister was thoroughly discussed and a new draft will emerge soon for final approval. The booklet is designed to complement the *Careers in Geophysics* booklet recently published by AGU; the booklets contain information about planning a career, job opportunities, educational requirements, and a synopsis of where the prospective student might apply.

Among other topics discussed were the following items: (1) AGU-sponsored lectureships for graduate student recruiting in oceanography; with no volunteers and no money for such lectureships, the booklet and individual efforts will have to suffice as recruiting devices; (2) AGU women's sessions sponsored by this committee will drop special reference to women, but the panel at the 1983 AGU Spring Meeting (Louise Levien, chair) will compare the advantages and drawbacks of careers in academia, industry, government or consulting; (3) the E & HR Committee will be developing a membership-wide questionnaire in order to improve and perhaps increase the committee's service to AGU.

The new edition of *Geophysics—The Earth in Space*, AGU's career booklet for high school students, is now available. The material has been updated and the format changed and expanded by use of pictures. In addition to the revision of this booklet, AGU has within the last year produced *Careers in Geophysics*, which is aimed at undergraduate and graduate-level college students, and the above-mentioned draft of an additional booklet on careers in oceanography. Individual copies of both *Geophysics—The Earth in Space* and *Careers in Geophysics* are available free of charge to students. In addition, larger supplies are available to professors and guidance counselors for their students upon specific request.

At the Fall Meeting our committee also sponsored a panel discussion (chaired by C. Sancetta) on 'Doubts and Discouragements: Beginning a Career.' About 50 people attended and a report of the session may be found in the Editorial section of this issue of *Eos*.

Charles Hollister
Woods Hole Oceanographic Institution
Chairman, AGU Education and Human Resources Committee

Meetings

Announcements

Ocean Data Presented

A large portion of the unpublished marine geological and geophysical data gathered in 1982 in the Aleutian-Bering Sea and the southwestern Pacific by the U.S. Geological Survey (USGS) research vessel RV *S. P. Lee* will be made available at a one-day 'show-n-tell' at the USGS in Menlo Park, Calif., on April 5, 1983. The data was collected as part of the Circum-Pacific Project, a cooperative effort involving about 25 countries that began last May. The project includes studies of active volcanoes along the Pacific 'ring of fire' and exploration for new oil, gas, and mineral resources.

Among the data to be displayed is that gathered from petroleum prospective areas near Tonga, Vanuatu (New Hebrides), and the Solomon Islands.

Michel T. Halbouty, chairman of the Circum-Pacific Council for Energy and Mineral Resources, will open the symposium with a keynote address on the national importance of scientific investigations of the Circum-Pacific rim. His address will be followed by a series of brief papers describing the purpose and nature of the work being exhibited, and some of the more important initial results.

Although no registration is required, those interested in attending should call Florence L. Wong (telephone: 415-856-7042) at the USGS in Menlo Park, Calif. General information about directions, local travel, and lodging may be obtained from Fran Moyer (telephone: 415-856-7143).

The 'show-n-tell,' the first of several symposia and workshops to be sponsored by the circum-Pacific section of the American Association of Petroleum Geologists (AAPG), also is sponsored by the Pacific marine geology branch of the USGS.

GAP

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Aeronomy

0410 Absorption and scattering of radiation (particles or waves)

THE AERONOMIC DISSOCIATION OF WATER VAPOUR BY SOLAR H LYMAN α RADIATION
B. R. Lewis, I. M. Vardavas and J. H. Carver (Research School of Physical Sciences, The Australian National University, Canberra, ACT, 2600, Australia)

The photoabsorption cross sections of molecular oxygen and water vapour have been measured as a function of temperature at 0.1 Å intervals between 1214 and 1219 Å. Over the width of the solar Lyman α line there is no fine structure apparent in the cross sections which were measured with 0.2 Å resolution. A large wavelength and temperature dependence is seen in the molecular oxygen cross sections but the variations are much smaller in the case of water vapour. The measured cross sections are used in calculations of the rate of photodissociation of atmospheric water vapour by solar Lyman α radiation, taking full account of both the temperature and wavelength dependences. It is found that the photodissociation rates may be accurately reproduced at altitudes above those where Lyman α ceases to dominate the dissociation by using molecular oxygen and water vapour cross sections corresponding to fixed temperatures near 200 K. Analytical models for these cross sections are presented for use in photochemical calculations. (Photoabsorption, photodissociation rates).
J. Geophys. Res., Blue, Paper 3A0258

0410 Absorption and scattering of radiation (particles or waves)

O_2 RADIATIVE PARAMETERIZATION USED IN CLIMATE MODELS: COMPARISON WITH NARROW BAND MODELS AND NEW LABORATORY DATA
J. I. Nishi (National Center for Atmospheric Research, Boulder, Colorado 80307) and V. Ramanathan

Absorptances for the 15 μm band system of CO_2 are calculated from three models: the Goody model, the Malkmus model and a wide band formulation. The wide band formulation used in this study explicitly accounts for hot and isotopic bands of CO_2. Comparison of results between these calculated absorptances and measured absorptances. The band models are in good agreement with the measured absorptances. The sensitivity of these models to increased CO_2 is investigated by intercomparing flux and heating rate changes computed by the three models. It is concluded that the difference in flux between the narrow band and wide band absorptance models, provided that the wide band models account explicitly for the various hot and isotopic bands of CO_2, is small. That significant errors result if the Goody or Malkmus model is applied to spectral intervals larger than 10 cm^{-1}. Thus our results suggest that climate models which employ Goody or Malkmus type models with coarser spectral resolution (> 10 cm^{-1}) may be subject to errors (in CO_2 fluxes and heating rates) larger than 10%. We also show the difference between the narrow and the wide band model treatment of H_2O-CO_2 overlap in the 15 μm region. The H_2O continuum absorption in the 15 μm region alters significantly the vertical distribution of CO_2 heating in the lower troposphere.
J. Geophys. Res., Green, Paper 3C0372

0430 Composition
SOLAR MESOSPHERE EXPLORER: SCIENTIFIC OBJECTIVES AND RESULTS
C.A. Barth (Laboratory for Atmospheric and Space Physics and Department of Astro-Geophysics, University of Colorado, Boulder, CO 80309) D.W. Rusch, R.J. Thomas, G.M. Mount, J. Rottman, G.E. Thomas, R.W. Sanders and G.M. Lawrence
Instruments on the Solar Mesosphere Explorer simultaneously measure ozone density, temperature, and solar ultraviolet flux. Results from six months of observations show that ozone density in the mesosphere changes from day-to-day and with the seasons and that the principal cause of these changes is the variation in atmospheric temperature. The dependence between ozone density and temperature is inverse, with a decrease in temperature producing an increase in ozone density. This dependence is observable in the seasonal patterns and also in orbit-to-orbit observations during dramatic atmosphere changes such as stratospheric warmings.
Geophys. Res. Lett., Paper 3L0322

0430 Composition
OZONE DENSITY DISTRIBUTION IN THE MESOSPHERE (50-90 KM) MEASURED BY THE SME LIMB SCANNING NEAR INFRARED SPECTROMETER
R.J. Thomas (Laboratory for Atmospheric and Space Physics and Department of Astro-Geophysics, University of Colorado, Boulder, CO 80309) C.A. Barth, D.W. Rottman, D.W. Rusch, G.M. Mount, G.M. Lawrence, R.W. Sanders, G.E. Thomas and L.E. Clemens.

The ozone densities between 50 and 90 km are deduced from 1.27 μm airglow measured on the Solar Mesosphere Explorer satellite. Initial results cover the entire mesosphere with those made simultaneously from SME by the ultraviolet spectrometer. The data set extends from late fall to early spring at most satellite latitudes. At low altitudes, in the mesosphere, there are larger variations in ozone density in the winter latitudes than in the summer. Above the meso-pause the day-to-day variation in ozone density is a factor of two at most latitudes and times.
Geophys. Res. Lett., Paper 3L0301

0430 Composition
MESOSPHERIC OZONE DEPLETION DURING THE SOLAR PROTON EVENT OF JULY 13, 1982 PART II. COMPARISON BETWEEN THEORY AND MEASUREMENTS
S. Solomon, (Aeronomy Laboratory, NOAA/ERL, Boulder, Colorado, 80303), G.C. Reid, D.W. Rusch, R.J. Thomas, (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, Colorado 80309).

The solar proton event of July 13, 1982 was the largest to date in the current solar cycle. Proton fluxes observed by the NOAA-6 satellite have been used to calculate ionization rates during the event, which have been found to be almost as large as those of the August, 1972 event near 70 km, but much smaller at lower altitudes. This ionization leads to the production of odd hydrogen radicals ($HO_x=H+OH+HO_2$) which catalytically destroy odd oxygen in the mesosphere and stratosphere. A one-dimensional time-dependent model has been used to calculate the percentage change in ozone resulting from this event. The calculated ozone depletion is compared to that observed by the Solar Mesosphere Explorer (SME) satellite.
Geophys. Res. Lett., Paper 3L0396

0430 Composition
ATOMIC NITROGEN ABUNDANCE IN POLAR UPPER THERMOSPHERE
G. G. Sivjee (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99706)

In night-time aurorae the intensity of highly excited ($n \geq 3$) N* line emissions is much less than 1% of the red and near-IR $N_2(1P)$ as well as $N_2^+(B^2\Sigma_u^+ \rightarrow X^2\Sigma_g^+)$ band emissions, while in mid-day cusp aurorae the ratio is greater than 10%. These observations point to electron impact on N (rather than on N_2) as the main source of some of the mid-day auroral N line emissions. To produce the measured level of 4P 6945-51 and 6978-82Å emissions, by cusp electrons impacting on N, requires the daytime polar thermospheric density of atomic nitrogen, above 200 km, to exceed of $10^7 cm^{-3}$. (cusp, thermosphere, atomic nitrogen abundance)
Geophys. Res. Lett., Paper 3L0299

0430 Composition (atomic or molecular)
TEMPERATURE MEASUREMENTS IN THE EARTH'S STRATOSPHERE USING A LIMB SCANNING VISIBLE LIGHT SPECTROMETER
D.W. Rusch (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309), G.M. Mount, J.W. Zawodny, C.A. Barth, D.J. Rottman, R.J. Thomas, G.E. Thomas, R.W. Sanders, and G.M. Lawrence.

The temperature of the earth's atmosphere between 40 and 60 km is inferred from measurements of Rayleigh scattered sunlight by a visible-light spectrometer on the Solar Mesosphere Explorer spacecraft. The RMS deviation of the satellite measurements from conventional rocket measurements is 6°K above 45 km and 2-3°K below 60 km. The satellite data are compared to model temperatures for March, 1982.
Geophys. Res. Lett., Paper 3L0409

0430 Composition (atomic or molecular)
COMPARISON OF MESOSPHERIC OZONE ABUNDANCES MEASURED BY THE SOLAR MESOSPHERE EXPLORER AND MODEL CALCULATIONS
S. Solomon, (Aeronomy Laboratory, NOAA/ERL,Boulder, Colorado 80303). D.W. Rusch, R.J. Thomas, R.W. Sanders, (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309).

Ozone observations in the mesosphere obtained by the near-infrared and ultraviolet spectrometers onboard the Solar Mesosphere Explorer (SME) satellite are compared to two dimensional model calculations for the month of January. In general, the model calculated abundances are somewhat smaller than those measured, but exhibit similar trends with respect to altitude and latitude. The possible causes of discrepancies include the mesospheric H_2O content and photochemical reaction rates, particularly the rate of O_2 photolysis.
Geophys. Res. Lett., Paper 3L0395

0430 Composition (atomic or molecular)
STRATOSPHERIC OZONE OBSERVATIONS BY OCCULTATION WITH SME AT 4.6μ.
R. L. Jones (SME Stratospheric Analysis, DSIR, Lauder, Otago, New Zealand), and F. T. Johnston.

A least squares data reduction technique for extracting stratospheric ozone abundances via spectrally resolved IR occultation is described. The technique was applied to ozone profiles obtained by the Solar Mesosphere Explorer (SME) satellite. Estimates of error are discussed and the overall accuracy of ozone retrievals is quantified in terms of the maximum residual errors accepted. Results obtained from the clean air site at Lauder New Zealand (45°S, 170°E) are presented for two periods (December 1982 to April 1983, and compared with Dobson total ozone values. Although less accurate ($\pm 20\%$) than the Dobson values, the technique may find use because both NO_2 and O_3 amounts are obtained simultaneously from the same sampled volume. Thus there is the potential for providing observational evidence for modelled photochemical...
Geophys. Res. Lett., Paper 3L0300

0440 Tides, waves and winds
POWER FLUX DUE TO RADAR MEASUREMENT OF WINDS AND VELOCITY VARIABILITY IN THE MESOSPHERE, STRATOSPHERE AND TROPOSPHERE
Ben B. Balsley (National Oceanic & Atmospheric Admin., Aeronomy Laboratory, Boulder, CO 80303)

The capability of the MST technique for measuring winds and wind variability in the mesosphere, stratosphere and troposphere is demonstrated using recent results obtained from the MST radar at Poker Flat, Alaska. Mesospheric results include mean flow, tidal motions and shorter term fluctuations. Stratospheric-tropospheric regimes include, in addition, high-frequency (>1/3) wave-like fluctuations observed in the vertical wind field.
Rad. Sci., Paper 3R0378

Physics of the Solid Earth
Volume 18, Number 5

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